Review of Particulate Matter Reporting for Coal Burning Facilities

Revised

March 21, 2006

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Executive Summary

In May 2004, a DNR Southeast Region (SER) air inspector completed a compliance inspection of the We Energies Valley Power Plant. During that inspection, he identified: 1) We Energies had understated its coal fired particulate emissions because it had not reported back-half emissions for these boilers these boilers and 2) We Energies failed to report fugitive dust emissions from its coal piles.

On July 1, 2004, the amended chapter NR 445, Wis. Adm. Code, became effective. In this chapter, section NR 445.10 addressed the control and compliance requirements for the handling and storage of coal. Companies stockpiling coal must address requirements for outdoor fugitive coal dust emissions, non-fugitive coal dust, and compliance certification by June 30, 2007. This requirement also highlighted the importance of accurate emissions reporting for coal fired facilities.

Although the SER compliance report focused on We Energies, it was not readily apparent whether the particulate matter under-calculation problem was specific to We Energies or consistent across all companies burning coal in Wisconsin. DNR completed a two-phase analysis to determine whether the reporting problem was statewide:

- For the back-half particulate matter emission analysis, company stack tests were reviewed from information available in the Wisconsin Air Compliance Database (WACD) and compared to what the company used for 2003 air emission reporting for a particular boiler.

- For the fugitive dust coal pile emission analysis, 2003 air emission reports were reviewed to determine how coal-burning power plants were reporting fugitive dust emissions from coal piles. Also a literature search was conducted which identified fugitive sources of particulate emissions associated with coal burning. This literature search identified coal piles, ash handling systems, and cooling towers as potential particulate matter emission sources.

The two completed analyses showed:

- There is no uniformity regarding the reporting of total particulate matter emissions from coal burning facilities in Wisconsin. It would appear that coal-burning installations may or may not factor back-half emission reporting in particulate matter calculations.

- Similarly, there also appears to be no uniformity regarding the reporting of fugitive dust emissions from coal piles. Many of the coal burning facilities did not report coal pile, ash handling systems, or cooling tower emissions and this lack of reporting may impeded the meeting NR 445.10 compliance certification requirements by June 30, 2007 for these companies

This document was written for the purpose of having consistent reporting particulate matter statewide from coal burning facilities.

Background

Definition of Particulate Matter

Federal and state regulations are clear in the definition of particulate matter. USEPA defines particulate matter in 40 CFR 51.100:

> "Particulate matter emissions means all finely divided solid or liquid material, other than uncombined water, emitted to the ambient air as measured by applicable reference methods, or an equivalent or alternative method, specified in this chapter, or by a test method specified in an approved State implementation plan."

Wisconsin defines the term "particulate matter emissions" in NR 400.02(119), Wis. Adm. Code, as follows:

> "Particulate matter emissions means all finely divided solid or liquid material, other than uncombined water, emitted to the ambient are as measured by an applicable reference method or an equivalent or alternative method specified by the department."

Based on the federal and state definitions of particulate matter, the measurement of particulate matter should include not only the solids (the front-half from the stack test results) but also the condensable (the back-half from the stack test results) particulate.

Quantification of Particulate Matter

Particulate matter is emitted with from a smokestack (which may or may not have a control device) or from fugitive sources that have no stack associated with the particulate generating activity.

The correct and consistent reporting of particulate matter air emissions in the annual air emission inventory has been a continual challenge. Emissions testing for the quantification of fugitive particulate matter emissions can be difficult and expensive to set-up and complete. Generally both the DNR and the regulated community have to rely on formulas contained in the USEPA document, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: *Stationary Point and Area Sources* in Chapter 13 Miscellaneous Sources. This chapter contains sections supplying information on the calculation of fugitive emissions from Section 13.2.1 Paved Roads; Section 13.2.2 Unpaved Roads; Section 13.2.3 Heavy Construction Operations, Section 13.2.4 Aggregate Handling and Storage piles; Section 13.2.5 Industrial Wind Erosion and Section 13.2.6 Abrasive Blasting.

For non-fugitive sources (i.e. smokestack emissions), particulate matter emissions can be determined through stack testing. The filterable fraction, the front-half, of the particulate is determined by using USEPA Stack Test Methods 5 or 17. The condensable fraction, the back-half, of the particulate matter is measured using USEPA Stack Test Method 202. Adding the results from the front-half and the back-half supplies the total particulate matter amount for that air pollutant source. From this stack testing information air emission factors can be developed and then annual particulate emissions from the facility can then be calculated.

Particulate Matter Reporting Concerns for Stack Tested Sources Burning Coal

In May 2004, a DNR Southeast Region (SER) air inspector completed a compliance inspection of the We Energies Valley Power Plant. During that inspection, he identified: 1) We Energies had understated its coal fired particulate emissions because it had not reported back-half emissions for on these boilers and 2) We Energies failed to report fugitive dust emissions from the fugitive emissions from its coal piles.

An analysis of stack testing information for We Energies from the Wisconsin Air Compliance Database (WACD) showed that We Energies had completed the proper stack testing using USEPA Method 5, for filterable particulate matter, and USEPA Method 202, for condensable particulate matter. However, We Energies only used the Method 5 results when calculating combustion particulate matter emissions for its air emission inventory report for its main plants at Oak Creek, Pleasant Prairie, and Valley. The following table shows the back-half emissions were significant.

After the discrepancy in the We Energy emissions were found, DNR completed a second analysis looking at the other major coal burning facilities in Wisconsin to determine whether the concern identified with the We Energy air emission reporting was limited to one company.

For the second analysis, DNR reviewed stack test information in the Wisconsin Air Compliance Database (WACD) and then compared it to information reported in the 2003 air emissions inventory The findings are summarized in the next table.

The particulate matter stack test information used in this table included the front-half and back-half catch results as shown in the columns labeled "Compliance PM Stack Test" The reported 2003 air emissions for the facility is listed under the three columns labeled "DNR Oracle Database". The calculated emissions based on the throughput and heat content reported by the company using the stack test information is listed in the column titled "Calc. PM Emis. Stack Test (Tons)". The difference between the column labeled "2003 Emis (tons)" and the column labeled "Calc. PM Emis. Stack Test (Tons)" is shown in the column labeled "Diff." This table shows the discrepancy from the calculated

2003 emissions versus emissions calculated by stack test information in the last column of the table. The table shows a large discrepancy between the calculated particulate matter emissions from coal fired boiler to coal fired boiler. The results of the tables show that stack test emission factors, which include the front-half and back-half catches contributions, should be used for calculating annual air emissions because the general AP-42 emission factors used for the emission calculations both over-report and under-report air emissions from these boilers.

Particulate Matter Reporting Concerns for Fugitive Dust Emissions for Sources Burning Coal

On July 1, 2004, the amended chapter NR 445, Wis. Adm. Code, became effective. In this chapter, section NR 445.10 addresses the control and compliance requirements for the handling and storage of coal. Companies stockpiling coal must address requirements for outdoor fugitive coal dust emissions, non-fugitive coal dust, and compliance certification by June 30, 2007.

DNR completed an inventory of fugitive dust emitting sources for large coal burning facilities in September 2004. This analysis was also used as a starting point for determining how coal burning facilities would meet compliance requirements listed in NR 445.10, Wis. Adm. Code, by June 30, 2007.

The table presented below summarizes the amount of fugitive particulate matter reported by facility for 2003 air emissions.

Fugitive Emission Summary Table

Company	Reported Fugitive Emissions (tons)	Generating Capacity (MW)	Tons of Emission/MW x 10^2
Alliant			
Columbia	87.5	1050	8.3
Nelson Dewey	0 (no coal combusted in 2003	226	0
Rock River	0 (coal combustion?)	150	0
Edgewater	0	818	0
Wisc. Pub. Service			
JP Pulliam	94.2	407	23
Weston	66.1	477.6	13.8
Mid- America Power			
E.J. Stoneman	0	No data found	0
WE Energy			
Pleasant Praire	11.2	1200	0.9
Oak Creek	31.1	1135	2.7
Valley	8.3	281	2.9
Port Washington	0	322	0
Milwaukee Cty	0	11	0
Dairyland			
Alma	0	207	0
Genoa	0	377	0
Manitowoc Pub. Utility			
701 Columbus St.	0.23	71	0.3
M G & E			
Blount St	14.51	122	11.9

Menasha Elec & Water			
River St	0	23	0
Xcel Energy			
Bayfront	0	74	0
UW			
Charter St	0	3.7	0

This table shows a large inconsistency regarding the reporting of fugitive emissions from these facilities.

In an effort to make this reporting consistent and to assist coal burning facilities to meet coal burning compliance requirements under NR 445.10, Wis. Adm. Code, DNR completed a review of existing literature for calculation of coal pile particulate matter and ash handling emissions. Based on this review, DNR believes fugitive particulate emissions from coal burning facilities can be generated by up to seven different processes. If applicable, these emission sources should be included in the facility's annual air emission inventory report:

- Any coal material transfer operation that is totally enclosed and vents to a bag house
- Any coal unloading operation that is not enclosed
- Coal pile wind erosion
- Coal pile maintenance
- Ash loading to enclosed trucks
- Ash loading to open trucks
- Cooling Towers. Cooling towers emit particulate matter through the evaporation of solids in the water and these solids are then blown out of the cooling tower into the atmosphere.

DNR also realizes that companies owning coal piles can initiate control of these emissions by watering, addition of surfactants, etc. Based on this information, DNR also noted activities that would be reduce by 50%, 75%, or 90% the particulate matter emissions. The specific emission calculation information by fugitive emission source for the seven identified fugitive emission sources is presented in the next four pages of this report.

Source / Description	Uncontrolled Emission equation /variable definition/source of Emission Factor	Variable values to be entered one time[1]	Annual input	50% Control efficiency requirements	75 % Control efficiency requirements	90 % Control efficiency requirements
Any material transfer operation that is totally enclosed and vents to a baghouse: Example: 1. Railcar unloading in a totally enclosed car shed 2. Crusher houses 3. Transfer stations	E = gr/dscf x ft^3 / hr x 7.14286 x 10^{-8} gr/ton x hours operated / year **variable definition**: E= emissions in tons ft^3/hr = flow rate into the baghouse gr/dscf = output of baghouse in grains per dry standard cubic feet (from stack test or vendor guarantee) **source:** Engineering calculation. Facilities may run a stack test and show lower emissions than vendor guarantee	gr/dscf = 0.010[2]. ft^3/hr =1620[3].	hours of operation	Control efficiency is already included in baghouse information		
Any unloading operation that is not enclosed:	$E = k(0.0032) \times \frac{(U/5)^{1..3}}{(M/2)^{1.4}}$	k = 1.0 for	tons of material	Watering spray bars	N/A	N/A

[1]There are 3 class of values for the variables listed here. Values followed by a **!** have values that must be used, values followed by a **?** must have site specific values entered by the facility, values followed by a **.** are suggested default values from literature but site specific values may be entered at the discretion of the facility.

[2] Air Pollution Engineering Manual , Buomicore and Davis, Air and Waste Management Association, 1992, page 115

[3] Air Pollution Engineering Manual , Buomicore and Davis, Air and Waste Management Association, 1992, page 117. Based on Figure 3 assumed a face velocityof 3 ft/min. Assumed an opening 3 feet high and 3 feet deep. Based on this assumption the flow rate was 27 cubic feet/minute or 1620 cubic feet/hour

Example: 1. Car train car unloading in a shed that is not enclosed. 2. Coal stacking conveyor unloading to a pile 3. Ash dumping to a pile (for ash unloading to trucks see below)	x 1 ton/2000 lb. x tons of coal unloaded /year **variable definition**: E= emissions in tons k= particle size multiplier U= mean wind speed (mph) M= material moisture content (%) **source:** AP 42 section 13.2.4 equation #1	TSP ! 0.35 for PM_{10} ! U = 10.3[4]. M= 6.9 %[5].	(coal, ash) unloaded			

[4] Average wind speed derived from data from the Wis. Climatology office
[5] Moisture value of 6.9% is from Table13.2.4-1 AP-42

<u>Coal pile wind erosion</u>: These are the emission from wind blowing across the coal pile	E= A x D x 1.7 x (s/1.5)x ((365-p)/235) x (f/15) x 1 ton/2000 lb. x k **variable definition**: E= emissions in tons/year A = acres of storage pile D = days in storage pile s = silt content of the coal p = days per year with greater than 0.01 inches of precipitation f= percent of time that wind is greater than 12 mph at mean pile height k= particle size multiplier **Source:** EPA-450/3-88-008equation # 4-9	D = 365. s = 6.2%[6]. p= 115[7]. f = 34%[8]. k= 1.0 for tsp.! = 0.5 for PM_{10}!	Area in acres of the storage pile for the year	NR 445 Dust Control Plan Submitted Water applied as required during windy conditions	NR 445 Dust Control Plan Submitted Water applied during all non freezing weather so that daily application from rain is 0.01 inches or from watering at a rate of 275 gallons per acres	NR 445 Dust Control Plan Submitted Water applied during all non freezing weather so that daily application from rain is 0.01 inches or from watering at a rate of 275 gallons per acres Surfactant or other chemical binder added for all coal that will be in storage during freezing weather or 4 sided enclosure with wall heights equal to or greater than height of the pile

[6] Silt value of 6.2% is from Table13.2.4-1 AP-42
[7] Derived from AP-42 figure 13.2.2-1
[8] Derived from data from Wisconsin Climatology Office

Coal pile maintenance: Vehicle travel on the pile	E= k x $(s/12)^a$ x $(W/3)^{0.45}$ x V x 1ton/2000lbs **variable definition**: E= emissions in tons/year k= particle size multiplier s = silt content % W = vehicle weight (tons) a = particle size correction factor V = vehicle mile traveled in the year **Source:** AP-42 –13.2.2 equation # 1a	k= 4.9 for tsp.! = 1.5 for PM_{10}! s = 6.2 %. W= 45 tons(loader weight. a= 0.7 for tsp.! = 0.9 for PM_{10}!	Vehicle mile traveled for the year	Same controls as for wind erosion	Same controls as for wind erosion	Same controls as for wind erosion
Ash loading to enclosed trucks: This is ash loading directly into an enclosed tanker truck	E= 0.61 lb. / ton of ash unloaded x 1ton/ 2000 lb. E= emissions in tons /year **Source:** Adapted from Fire SCC 30501626 – lime loading to an enclosed truck		Tons of ash loaded	Control is built in the emission factor since this is loading to an enclosed truck		
Ash loading to open trucks: This is ash loading directly into open trucks.	E= 1.5 lb. / ton of ash unloaded x 1ton/ 2000 lb. E= emissions in tons /year **Source:** Adapted from Fire SCC 30501627 – lime loading to an open truck		Tons of ash loaded yearly		If ash is wet to form a snowball then 75% control can be claimed	

Cooling Tower:	**E = g x wt x p x c x d x MWh/year x 1ton/ 2000 lb.** **variable definition**: E = emission in tons per year g= tower design flow rate (gals/MWh) wt = weight of water (lb.) p = solids in water in ppm c = number of cycles of concentration in the cooling tower (#) d = drift loss (%) **Source:** **Engineering Equation**	g = ? wt = 8.345 lb./gal ! p = ? c = ? d = ?	MWh produced annually			

Changes to 2005 and future Air Emission Inventories

Based on information presented in tables in the last section, DNR reviewed each facility reporting coal burning emissions in 2004 and added fugitive coal sources to these facilities if they were not part of the facility's 2004 air emission inventory. The information added to those facilities is shown in the table below:

Fugitive Dust Emission Sources From Coal Handling and Storage

Emission Source	SCC	Pollutant	EMF	EMF Unit	Fugitive Control Efficiency	Throughput Unit	Mandatory or Optional
Transfer Operation that is not totally enclosed	30501011	PM	1.45E-03	lb/ton coal	50	Ton Coal	Mandatory
		PM10	5.06E-04	lb/ton coal	50	Ton Coal	Mandatory
Any material transfer operation that is totally enclosed and vents to a baghouse	30501008	PM	2.31E-03	lb/hours of operation	0	Hours of operation	Optional
		PM10	1.39E-03	lb/hours of operation	0	Hours of operation	Optional
Coal pile wind erosion	30501043	PM	6184.463	lb/acre	50	Acre Coal	Added
		PM10	3092.232	lb/acre	50	Acre Coal	Added
Coal pile maintenance	30501031	PM	10.43961	lb/Vehicle Mile Traveled	50	Vehicle Mile Traveled	Added
		PM10	2.800411	lb/Vehicle Mile Traveled	50	Vehicle Mile Traveled	Added
Ash loading to enclosed trucks:	30700123	PM	6.10E-01	lb/ton ash	0	ton ash	Optional
		PM10	3.66E-01	lb/ton ash	0	ton ash	Optional
Ash loading to open trucks:	30700124	PM	1.5	lb/ton ash	0	ton ash	Added
		PM10	0.9	lb/ton ash	0	ton ash	Added
Cooling Tower:	30600701	PM	formula	lb/million gallons cooling water	0	million gallons cooling water	Optional
		PM10	formula	lb/million gallons cooling water	0	million gallons cooling water	Optional

DNR added information from the table with yellow highlighting and the word "added" in the furthest right column of this table for facilities that had not reported this information for 2005 and future emission inventories.

Summary

DNR completed two analyses of data from coal burning facilities. The first analysis compared reporting of particulate matter emissions from facilities in which stack test information was used to calculate air emissions versus USEPA emission factors. The second analysis reviewed the reporting of fugitive particulate matter emission sources. For both the stationary point sources and the fugitive particulate matter sources, large inconsistencies in reported emissions occurred were identified. In order to resolve these reporting inconsistencies statewide DNR proposes:

- Substitute stack test information for USEPA AP42 emission factors when the data has been quality assured and approved by DNR. The emission factors developed from the stack test should include the front-half and back-half catches of particulate matter.

- For companies not reporting fugitive particulate matter emitting sources, add up to seven sources to the facility's emission inventory that account for coal pile, ash handling, and cooling tower emissions. Assign 50%, 75%, or 90% control efficiency for some of these fugitive particulate matter emission sources depending on practices used by the company to reduce fugitive particulate matter emissions at the facility.